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(72) Inventor: JUHANI VASE

(54) METHOD FOR THE TREATMENT OF PAPER AND CARDBOARD TO MAKE THEM WATER AND WATER VAPOR RESISTANT

(71) We, KEMI OY, a company organised and existing under the laws of Finland, of 94200 Kemi 20, Finland, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to the treatment of paper and cardboard to make them water and water vapour resistant.

Fibrous substrates, such as paper and cardboard, are widely used in the packaging industry. However, paper and cardboard are only poorly resistant to the penetration of water and water vapour. To improve the resistance of paper and cardboard to water and water vapour various impregnation and coating treatments have been proposed. The most common coating material is wax. Wax-coated paper and cardboard repel water, but their endurance to water is poor and their permeability to water vapour is high, especially after folding. Wax is also brittle and folding tends to break the wax layer so that water vapour penetrates through the cavities in the wax. Other disadvantages of wax-coated products are low friction, difficulties in gluing, and the fact that the products are not repulpable. Moreover, the wax does not form a hard and scuff resistant surface.

Efforts hve also been made to coat paper with bitumen and even though a good initial water vapour resistance is obtained, this resistance falls on folding. Furthermore, bitumen is a black, poisonous material, which restricts its use as a paper coating, especially in foodstuff packaging industry. In addition to this, bitumen coatings are inclined to soften when the temperature increases. Polyethylene film has also been applied as a paper coating. It has been observed that such polyethylene-coated paper has a lower water vapour resistance than the wax-coated paper, when the coating is tested flat or unfolded, although there is less of a tendency for the coating to crack on folding so that the water vapour resistance of the polyethylene coated product is better. A further disadvantage of polyethylene-coated cardboard is that it cannot be run through a corrugating machine, as the polyethylene melts at the operating temperature of the double facer of the machine. Also polyethylene-coated material is not repulpable, as is also the case with waxed material. Amongst other products on the market "hot melt" curtain coated packaging products should be mentioned. In these a mixture of wax and polyethylene is generally used as the coating material. The product has a relatively good water vapour resistance. The disadvantage is, however, that the curtain-wax treatment can be applied only to complete box blanks, which reduces the competitiveness of the product. Also, once again, it is not possible to repulp the curtain-waxed packaging material.

Mention should also be made of the so-called "Secor-process", which has been found to be good for improving the water resistance of corrugated cardboard. In the Secor process corrugated cardboard is totally impregnated with wax. The material treated in this way has a good moisture resistance and it retains its stiffness relatively well even at high moisture conditions. However, the price of the product is high and it is not repulpable.

In the packaging field it has therefore become extremely desirable to find a packaging

material having the following properties:

1 retention of strength, especially stiffness, even under high moisture conditions during long storage periods;
2 good water vapour resistance;
3 is repulpable, this property becoming increasingly important, as the demand for fiber recycling increases.

In addition to these important properties the following properties, e.g. are also desirable:

- can be printed with normal printing colours,
- can be glued with normal glues,
- can be run under normal machine running conditions, e.g. in corrugating machines,
- has a high enough friction to permit safe stacking of boxes,
- contains no substances injurious to health, especially in foodstuff packaging.

The present invention seeks to provide a method for the treatment of paper and cardboard which fulfils one or more of the above requirements.

In accordance with the invention, there is provided a method of improving the resistance to water and water vapour of packaging materials selected from paper and cardboard, which comprises applying to the paper or cardboard an unpigmented aqueous latex coating composition comprising (a) an acrylic polymer selected from copolymers of an acrylate monomer and styrene, acrylonitrile polymers and copolymers, and copolymers of an acrylate monomer with styrene and butadiene, and (b) a metal stearate and/or wax, component (a) being present in said composition in an amount of from 35-95% by weight, based on the combined weights of (a) and (b), and drying the coated paper or cardboard to deposit thereon a coating of said acrylic polymer in admixture with said metal stearate and/or said wax, with the proviso that when component (b) is a wax, the wax is present in an amount of at least 20% by weight of (a) and (b).

In the method of this invention the coating may be applied to the paper or cardboard substrate by any of the well-known techniques such as metering bar coating, blade coating and air knife coating.

The packaging materials to which the present invention applies include all types and quality of paper and cardboard used for packaging and wrapping purposes.

The products of the invention can be used for:

- packing and transportation of deep frozen fish and meat
- packing and transportation of vegetable (tomato, lettuce etc.) and fruit
- transportation of domestic animals
- wrapping paper for lumber or paper and board rolls
- such purposes in general, where the packing material must have a good moisture resistance.

The coating compositions used in this invention preferably contain from 50-80%, by weight of acrylic polymer, based on the combined weight of the polymer and the wax and/or metal stearate, and may be applied at coating weights of from 3-25 g/m^2, preferably 5-10 g/m^2. Preferred wax components are mineral waxes especially straight chain microcrystalline waxes of m.p. in the range 50-80°C. The preferred metal stearate is calcium stearate.

The following example illustrates the method of this invention and the properties of the products obtained. The coating mixture comprises an unpigmented aqueous latex containing equal amounts by weight of an acrylate/styrene copolymer and calcium stearate. Approximately 10 g/m^2 of the coating composition is applied to the substrate, after which the substrate is dried using a normal drying technique.

Thereafter the material can be used as such for wrapping purposes, or it can be further processed into corrugated cardboard or similar products. The physical properties of the kraftliner board coated in the above mentioned way were tested and the results are shown in Table 1. This coated board is compared with uncoated liner board and dry-waxed liner board (wax coating 25 g/m^2).

EXAMPLE

Coating experiment for kraftliner board

A) *Testing methods*

Water absorption of glued paper and board after Cobb's method SCAN-P 12:64

The water absorption of paper (Cobb-value) is defined as the amount of water which one or the other side of the paper absorbs in a given time from a 1 cm thick water layer, which covers the paper evenly.

Moisture and water vapor permeability

A.S.T.M. 3-988 (tropical conditions). Expressed as grams H_2O/m^2)24h, 65% RH/20°C and 90% RH/38°C.

B) *Results*

TABLE 1

	Invention			Comparison			
				Waxed liner		Stand. quality 175 g/m²	
	Roll 1	Roll 2	Roll 3				
Friction coefficient	11-*1*	11-*1*	11-*1*	11-*1*	11-11	11-*1*	11-11
- static friction	0,15	0,16	0,14	0,17	0,16	0,53	0,54
- kinetic friction	0,78	0,18	0,19	0,12	0,11	0,47	0,49
Cobb 30 min g/m²	2,15	2,30	2,26	47,6		276,1	
Water vapor permeability g/m²/24h							
65 % RH, 20°C	21,83	15,15	17,36	52,0		575,0	
90 % RH, 38°C	155,3	162,7	176,1	391,0		2462,0	

Repulpability: The liner boards heated in accordance with this invention were repulpable quite equally to uncoated liner. Repulpability of the waxed liner was poor.

Corrugated board boxes made of coated liner were tested by exposing them for seven days to 90 % RH/20°C and also after artificial raining. They were compared with boxes of uncoated and curtain-coated liner. The results are shown in Table 2.

TABLE 2

	Untreated	Curtain-coated	Invention
t = 20°C, RH = 65%			
Basis weight, g/m^2	528	571	561
Puncture resistance, J	4,4	4,4	4,4
Flat crush resistance, kN/m^2	357	290	350
Compression resistance, N	2290	2223	2685
t = 20°C RH = 90%			
Puncture resistance	4,2	4,5	4,4
Flat crush resistance	196	250	299
Compression resistance	1044	2122	2281
t = 20°C. RH = 65% + 5 min. watering + 10 min conditioning			
Puncture resistance	4,2	4,4	4,5
Flat crush resistance	200	255	298
Compression resistance	1086	2476	2804

WHAT WE CLAIM IS:-

1. A method of improving the resistance to water and water vapour of packaging materials selected from paper and cardboard, which comprises applying to the paper or cardboard an unpigmented aqueous latex coating composition comprising (a) an acrylic polymer selected from copolymers of an acrylate monomer and styrene, acrylonitrile polymers and copolymers, and copolymers of an acrylate monomer with styrene and butadiene, and (b) a metal stearate and/or wax, component (a) being present in said composition in an amount of from 35-95% by weight, based on the combined weights of (a) and (b), and drying the coated paper or cardboard to deposit thereon a coating of said acrylic polymer in admixture with said metal stearate and/or said wax, with the proviso that when component (b) is a wax, the wax is present in an amount of at least 20% by weight of (a) and (b).
2. A method according to claim 1, wherein said composition contains from 50-80% by weight of said acrylic polymer, based on the combined weights of (a) and (b).
3. A method according to claim 1 or 2, wherein said composition is deposited on the paper or cardboard at a coating weight of from 3-25 g/m^2.
4. A method according to claim 3, wherein said coating weight is from 5-10 g/m^2.
5. A method according to any one of the preceding claims, wherein component (b) of the coating composition is a mineral wax.
6. A method according to claim 5, wherein the wax is a straight chain microcrystalline wax, m.p. 50-80°C.

7. A method according to any one of claims 1 - 4, wherein component (b) of the composition is calcium stearate.

For the Applicants,
D. YOUNG & CO.,
Chartered Patent Agents,
10 Staple Inn,
London, WC1V 7RD.

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